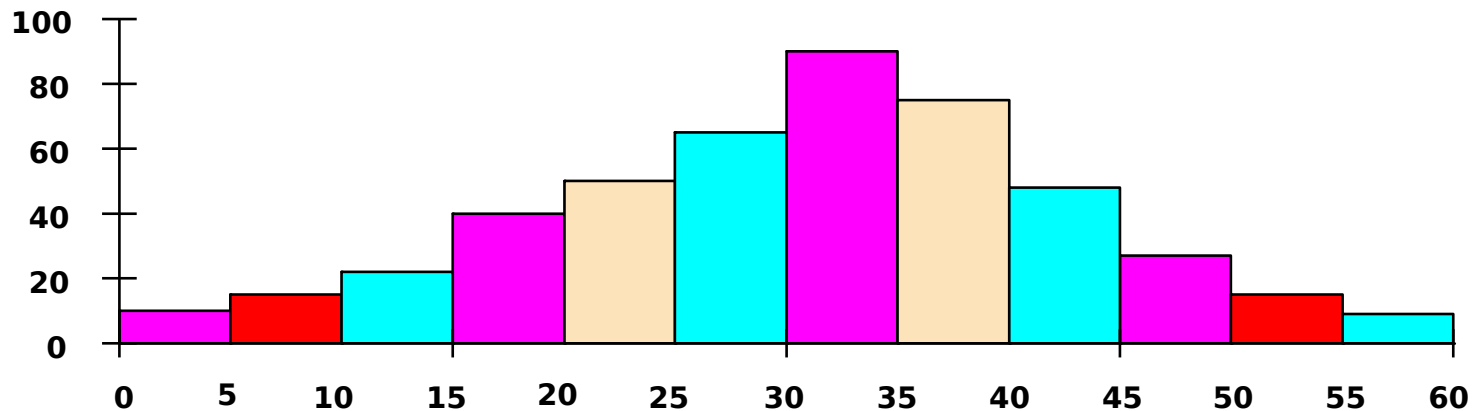


What Is a Histogram?

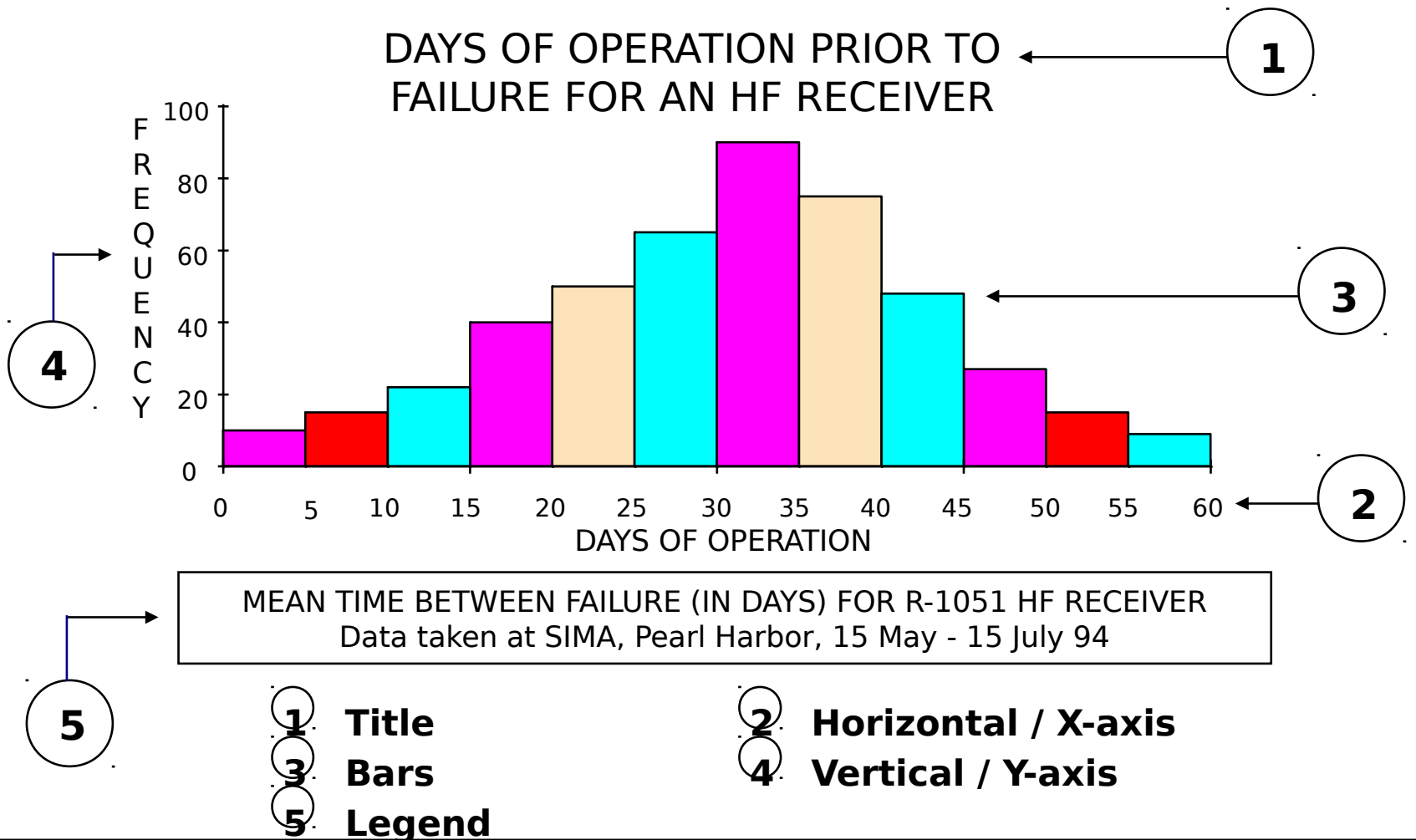


- A bar graph that shows the distribution of data
- A snapshot of data taken from a process

When Are Histograms Used?

- Summarize large data sets graphically
- Compare measurements to specifications
- Communicate information to the team
- Assist in decision making

Parts of a Histogram



Constructing a Histogram

Step 1 - Count number of data points

Step 2 - Summarize on a tally sheet

Step 3 - Compute the range

Step 4 - Determine number of intervals

Constructing a Histogram

Step 6 - Determine interval starting points

Step 7 - Count number of points in each interval

Step 8 - Plot the data

Step 9 - Add title and legend

How to Construct a Histogram

Step 1 - Count the total number of data points

Number of yards long (+ data) and yards short (- data) that a gun crew missed its target.

-180	30	190	380	330	140	160	270	10	- 90
- 10	30	60	230	90	120	10	50	250	180
-130	220	170	130	- 50	- 80	180	100	110	200
260	190	-100	150	210	140	-130	130	150	370
160	180	240	260	- 20	- 80	30	80	240	130
210	40	70	- 70	250	360	120	- 60	- 30	200
50	20	30	280	410	70	- 10	20	130	170
140	220	- 40	290	90	100	- 30	340	20	80
210	130	350	250	- 20	230	180	130	- 30	210
-30	80	270	320	30	240	120	100	20	70
300	260	20	40	- 20	250	310	40	200	190
110	-30	50	240	180	50	130	200	280	60
260	70	100	140	80	190	100	270	140	80
110	130	120	30	70					

TOTAL = 135

How to Construct a Histogram

Step 2 - Summarize the data on a tally sheet

DATA	TALLY	DATA	TALLY	DATA	TALLY	DATA	TALLY	DATA	TALLY
- 180	1	- 20	3	90	2	190	4	290	1
- 130	2	- 10	2	100	5	200	4	300	1
- 100	1	10	2	110	3	210	4	310	1
- 90	1	20	5	120	4	220	2	320	1
- 80	2	30	6	130	8	230	2	330	1
- 70	1	40	3	140	5	240	4	340	1
- 60	1	50	4	150	2	250	4	350	1
- 50	1	60	2	160	2	260	4	360	1
- 40	1	70	5	170	2	270	3	370	1
- 30	5	80	5	180	5	280	2	380	1
								410	1

How to Construct a Histogram

Step 3 - Compute the range for the data set

Largest value = + 410 yards past target

Smallest value = - 180 yards short of target

Range of values = 590 yards

Calculation: $+ 410 - (- 180) = 410 + 180 = 590$

How to Construct a Histogram

Step 4 - Determine the number of intervals required

*IF YOU HAVE THIS
MANY DATA POINTS*

*USE THIS NUMBER
OF INTERVALS:*

Less than 50

5 to 7 intervals

50 to 99

6 to 10 intervals

100 to 250

7 to 12 intervals

More than
250

10 to 20 intervals

How to Construct a Histogram

Step 5 - Compute the interval width

Interval Width = $\frac{\text{Range}}{\text{Number of Intervals}} = \frac{590}{10} = 59$

Use 10 for the number of intervals

Round up to 60

How to Construct a Histogram

Step 6 - Determine the starting point of each interval

Step 7 - Count the number of points in each interval

<u>INTERVAL NUMBER</u>	<u>STARTING VALUE</u>	<u>INTERVAL WIDTH</u>	<u>ENDING VALUE</u>	<u>NUMBER OF COUNTS</u>
1	-180	60	-120	3
2	-120	60	-060	5
3	-060	60	000	13
4	000	60	060	20
5	060	60	120	22
6	120	60	180	24
7	180	60	240	20
8	240	60	300	18
9	300	60	360	6
10	360	60	420	4

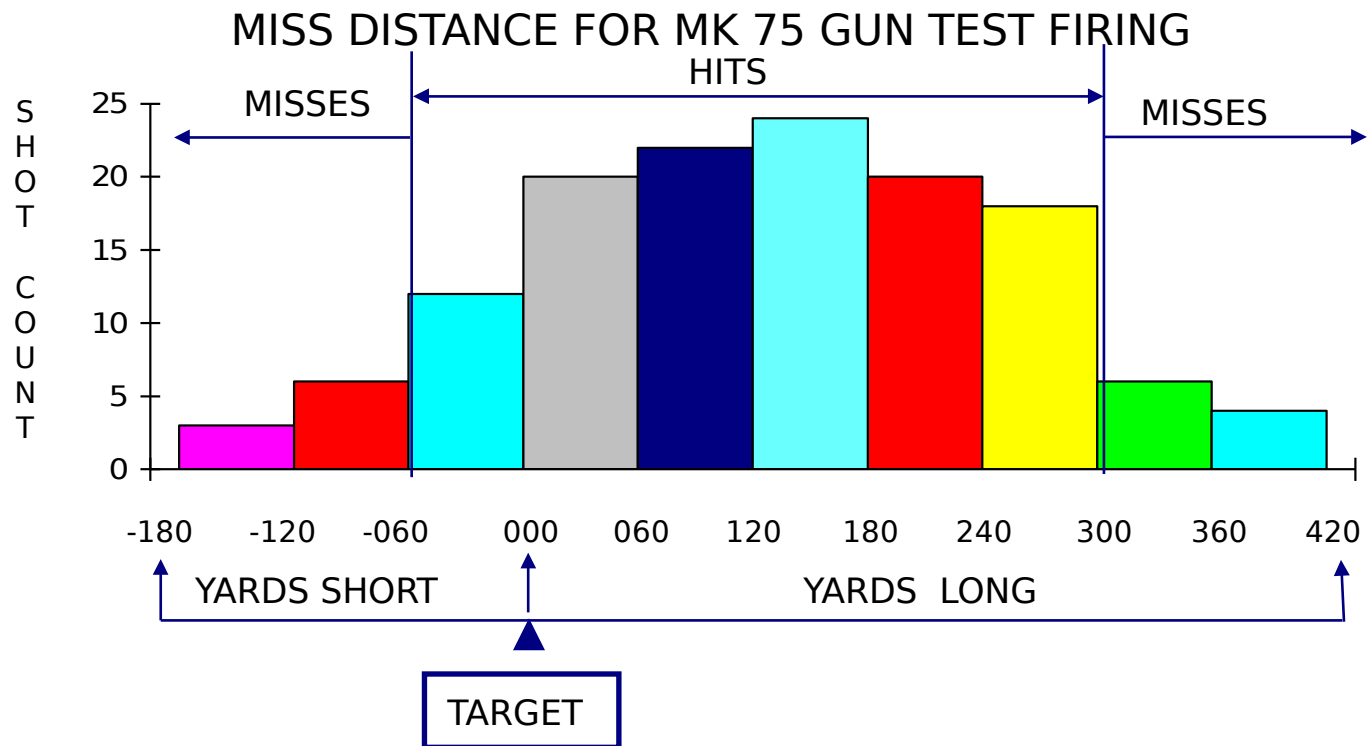
Equal to or greater than the
STARTING VALUE

But less than the
ENDING VALUE

How to Construct a Histogram

Step 8 - Plot the data

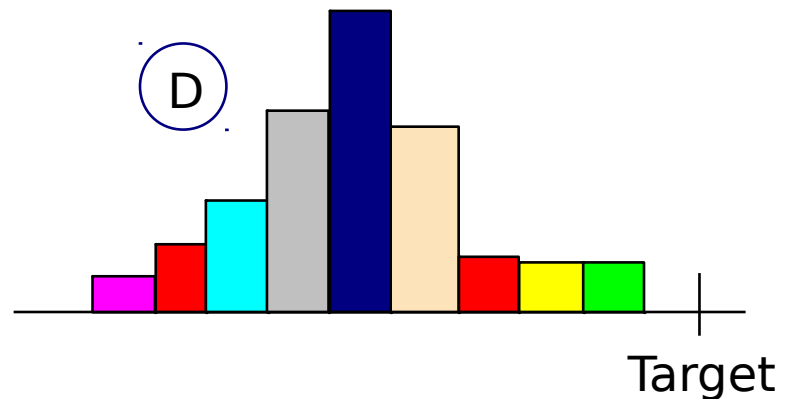
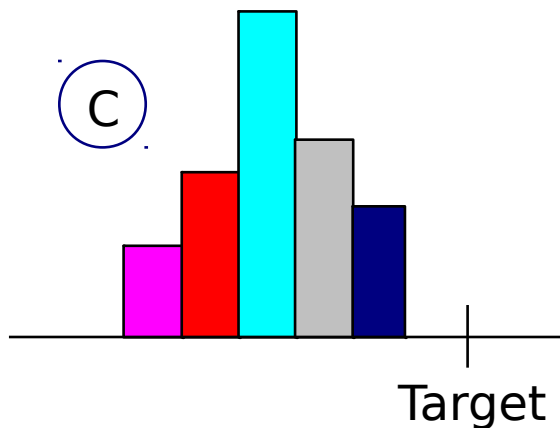
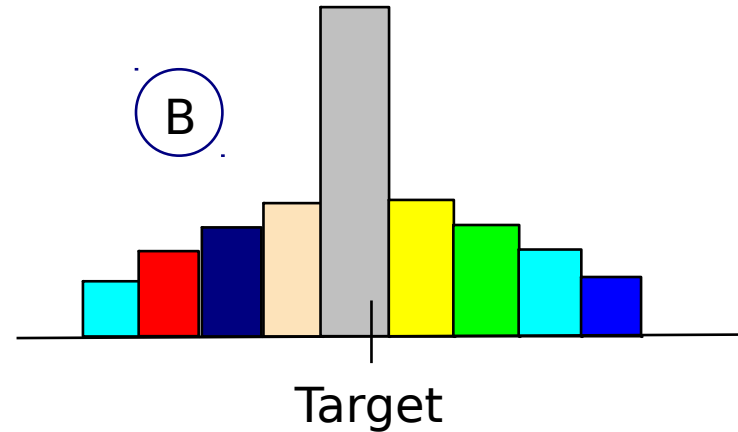
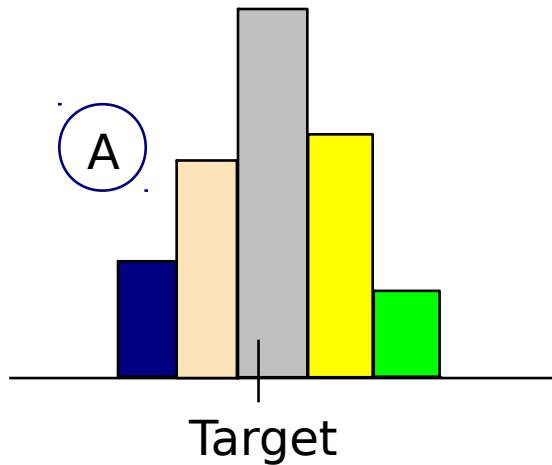
Step 9 - Add the title and legend



LEGEND: USS CROMMELIN (FFG-37), PACIFIC MISSILE FIRING RANGE, 135 BL&P ROUNDS/MOUNT 31, 25 JUNE 94

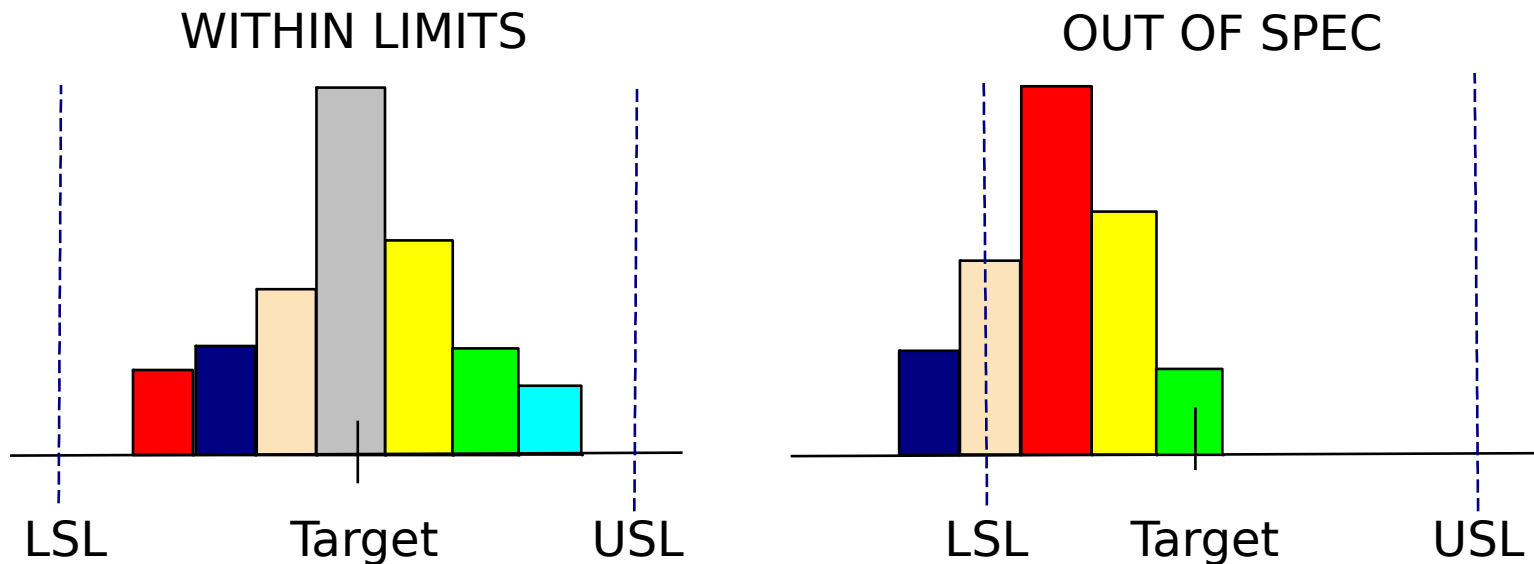
Interpreting Histograms

Location and Spread of Data



Interpreting Histograms

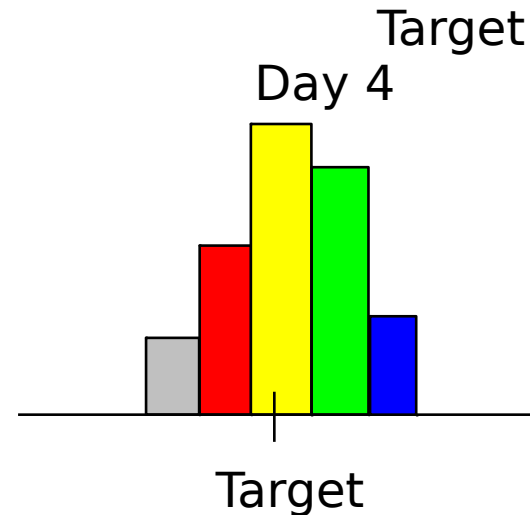
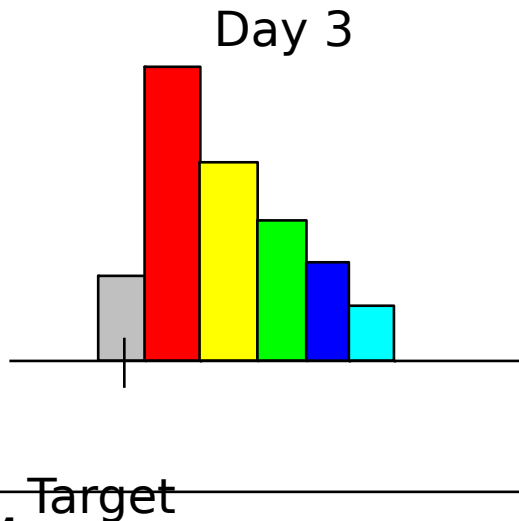
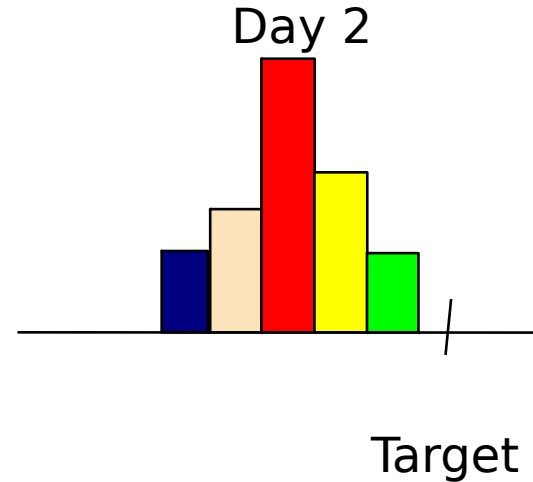
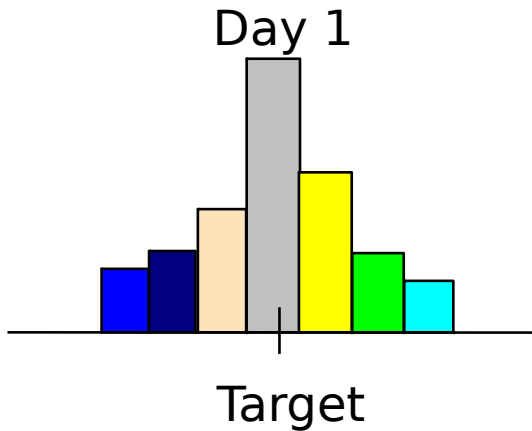
Is Process Within Specification Limits?



LSL = Lower specification limit
USL = Upper specification limit

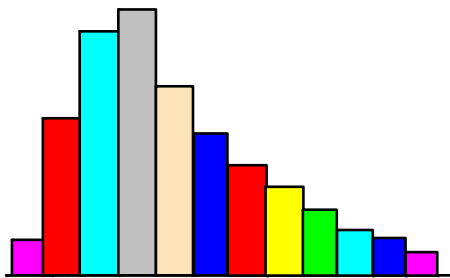
Interpreting Histograms

Process Variation

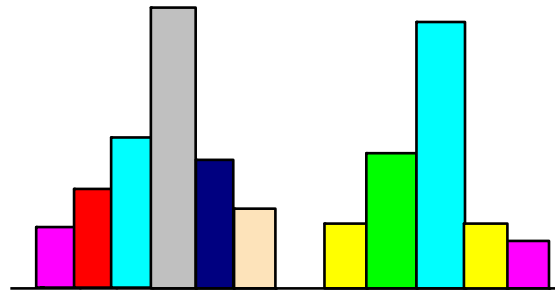


Interpreting Histograms

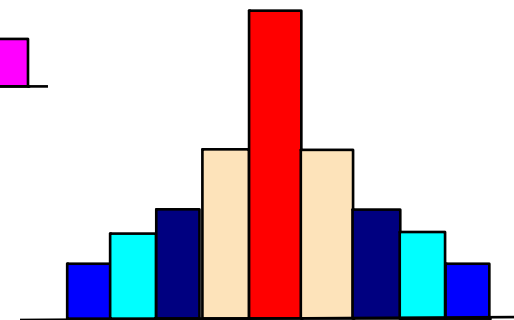
Common Histogram Shapes



Skewed
(not
symmetrical)



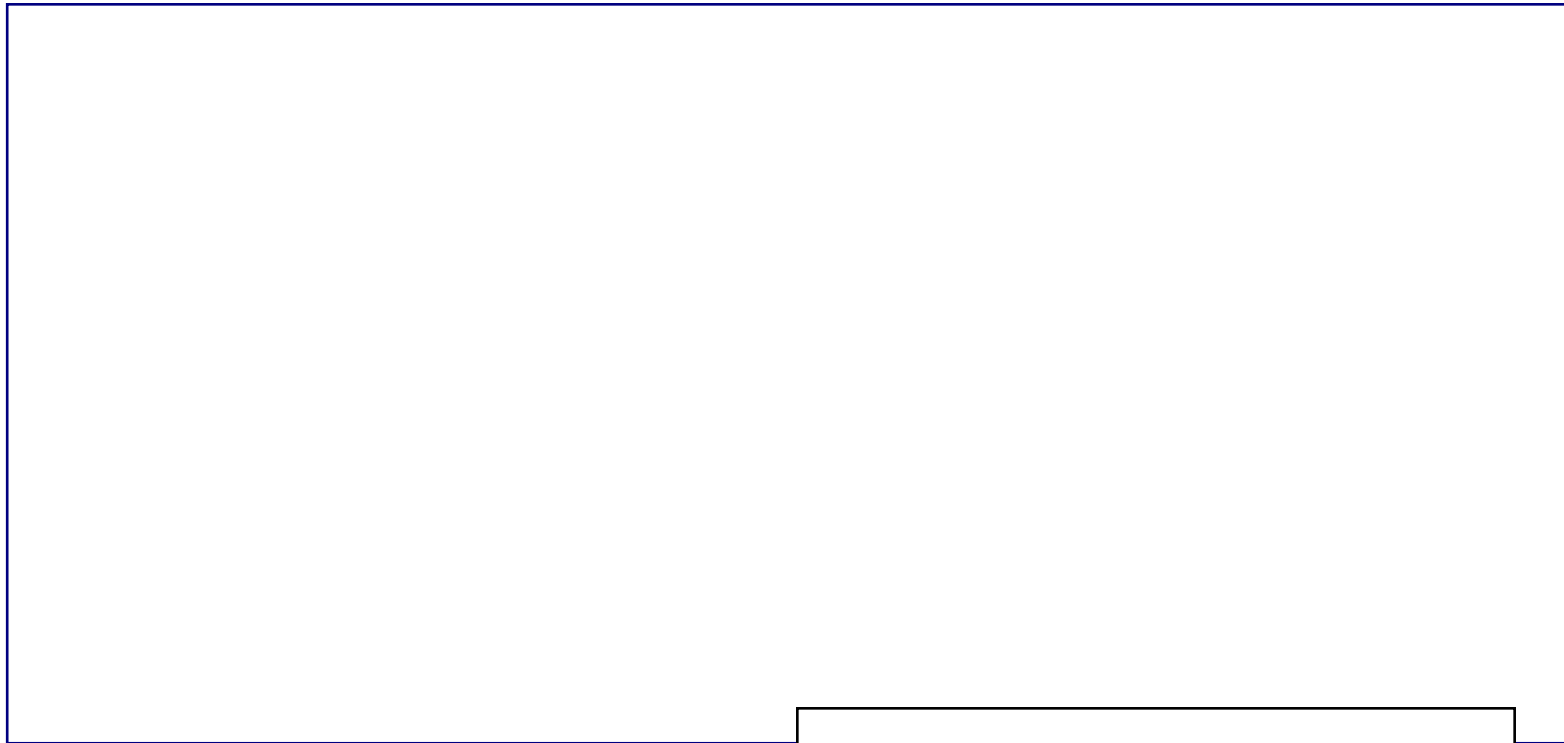
Discontinued



Symmetrical
(mirror
imaged)

WORKSHEET

Step 1 - Count the number of data points



TOTAL NUMBER =

WORKSHEET

Step 2 - Summarize the data on a tally sheet

VALUE	TALLY	VALUE	TALLY	VALUE	TALLY	VALUE	TALLY	VALUE	TALLY

WORKSHEET

Step 3 - Compute the range for the data set

Largest value = _____

Smallest value = _____

Range of values = _____

WORKSHEET

Step 4 - Determine the number of intervals

*IF YOU HAVE THIS
MANY DATA POINTS*

*USE THIS NUMBER
OF INTERVALS:*

Less than 50

5 to 7

intervals

50 to 99

6 to 10

intervals

100 to 250

More than

250

7 to 12

intervals

10 to 20

intervals

WORKSHEET

Step 5 - Compute the interval width

Interval Width = $\frac{\text{Range}}{\text{Number of Intervals}}$ = _____ = ○

Round up to next higher whole number

WORKSHEET

Step 6 - Determine the starting point of each interval

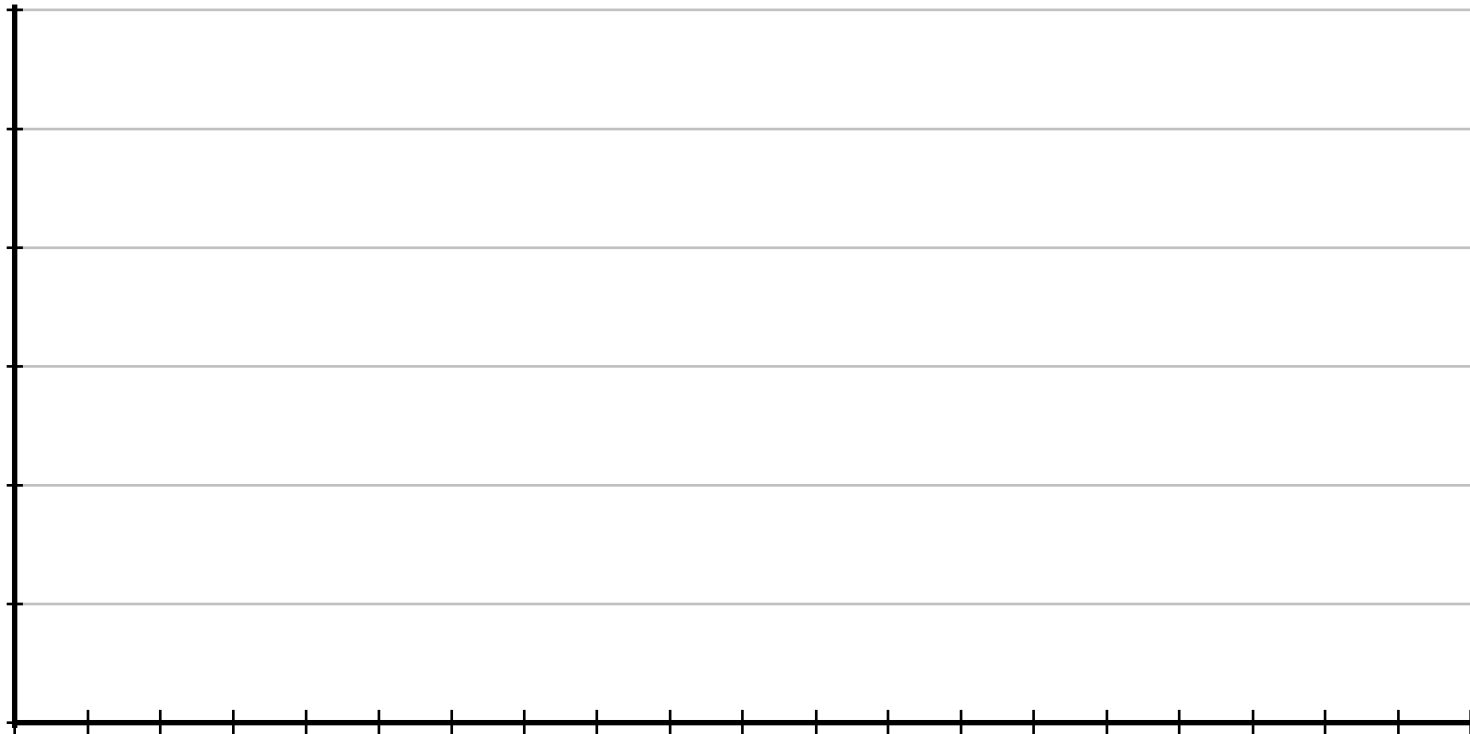
Step 7 - Count the number of points in each interval

INTERVAL NUMBER	STARTING VALUE	INTERVAL WIDTH	ENDING VALUE	NUMBER OF COUNTS
1				
2				
3				
4				
5				
6				
7				
8				
9				
10				

WORKSHEET

Step 8 - Plot the data

Step 9 - Add title and legend



EXERCISE 1 ANSWER KEY

Step 1 - Count the number of data points

11	22	15	7	13	20	25	12	16	19
4	14	11	16	18	32	10	16	17	10
8	11	23	14	16	10	5	21	26	10
23	12	10	16	17	24	11	20	9	13
24	10	16	18	22	15	13	19	15	
24									
11	20	15	13	9	18	22	16	18	9
14	20	11	19	10	17	15	12	17	11
17	11	15	11	15	16	12	20	14	12

TOTAL = 80

EXERCISE 1 ANSWER KEY

Step 2 - Summarize the data on a tally sheet

<u>% FAT</u>	<u>NO. OF PERS</u>	<u>% FAT</u>	<u>NO. OF PERS</u>	<u>% FAT</u>	<u>NO. OF PERS</u>
0	0	11	9	22	3
1	0	12	4	23	2
2	0	13	5	24	3
3	0	14	4	25	1
4	1	15	7	26	1
5	1	16	8	27	0
6	0	17	5	28	1
7	1	18	4	29	0
8	1	19	3	30	0
9	3	20	4	31	0
10	7	21	1	32	1

EXERCISE 1 ANSWER KEY

Step 3 - Compute the range for the data set

Largest value = 32 Percent body fat

Smallest value = 4 Percent body fat

Range of values = 28 Percent body fat

EXERCISE 1 ANSWER KEY

Step 4 - Determine the number of intervals

*IF YOU HAVE THIS
MANY DATA POINTS*

*USE THIS NUMBER
OF INTERVALS:*

Less than 50

5 to 7 intervals

50 to 99

6 to 10 intervals

100 to 250

7 to 12 intervals

More than
250

10 to 20 intervals

EXERCISE 1 ANSWER KEY

Step 5 - Compute the interval width

The diagram illustrates the calculation of the interval width. It starts with a box labeled "Interval Width" followed by an equals sign. This is followed by a fraction where the numerator is "Range" (with the value 28 written above it) and the denominator is "Number of Intervals" (with the value 8 written below it). This fraction is followed by another equals sign and a circle containing the value 3.5. Below the denominator "Number of Intervals", there is a box containing the text "Use 8 for the number of intervals" with an arrow pointing to the number 8. To the right of the circle containing 3.5, there is a box containing the text "Round up to 4" with an arrow pointing up to the circle.

$$\text{Interval Width} = \frac{\text{Range}}{\text{Number of Intervals}} = \frac{28}{8} = 3.5$$

Use 8 for the number of intervals

Round up to 4

EXERCISE 1 ANSWER KEY

Step 6 - Determine the starting point of each interval

Step 7 - Count the number of points in each interval

INTERVAL NUMBER	STARTING VALUE	INTERVAL WIDTH	ENDING VALUE	NUMBER OF COUNTS
1	4	+ 4	8	3
2	8	+ 4	12	20
3	12	+ 4	16	20
4	16	+ 4	20	20
5	20	+ 4	24	10
6	24	+ 4	28	5
7	28	+ 4	32	1
8	32	+ 4	36	1

Equal to or greater
than
the STARTING VALUE

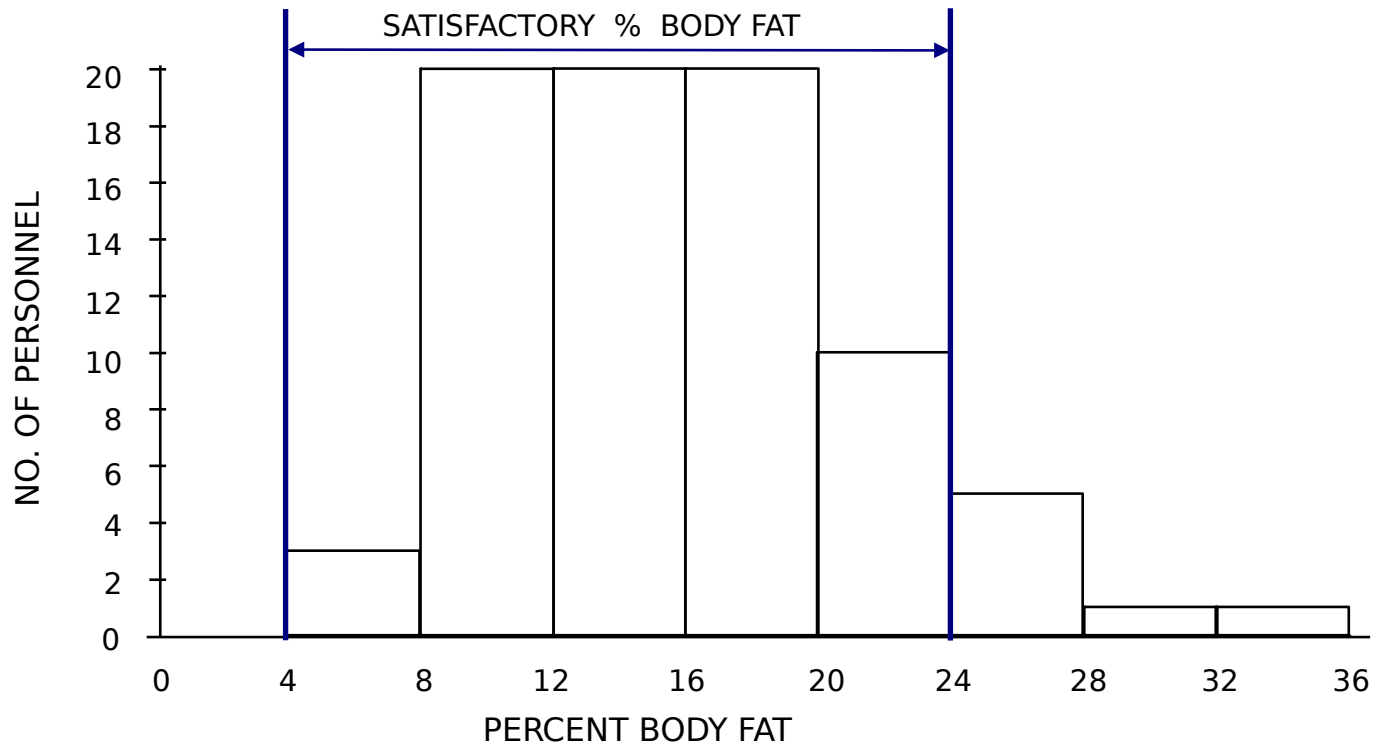
But less than
the ENDING VALUE

EXERCISE 1 ANSWER KEY

Step 8 - Plot the data

Step 9 - Add title and legend

JUNE 94 PRT PERCENT BODY FAT



LEGEND: USS LEADER (MSO-490), 25 JUNE 94, ALL 80 PERSONNEL SAMPLED

EXERCISE 2 ANSWER KEY

Step 1 - Count the number of data points

160	190	155	300	280	185	250	285	200	165
175	190	210	225	275	240	170	185	215	220
270	265	255	235	170	175	185	195	200	260
180	245	270	200	200	220	265	270	250	230
255	180	260	240	245	170	205	260	215	
185									
255	245	210	225	225	235	230	230	195	225
230	255	235	195	220	210	235	240	200	220
195	235	230	215	225	235	225	200	245	230
220	215	225	250	220	245	195	235	225	230
210	240	215	230	220	225	200	235	215	240
220	230	225	215	225					
								TOTAL = 105	

EXERCISE 2 ANSWER KEY

Step 2 - Summarize the data on a tally sheet

<u>SCORE</u>	<u>TALLY</u>	<u>SCORE</u>	<u>TALLY</u>	<u>SCORE</u>	<u>TALLY</u>
155	1	205	1	255	4
160	1	210	4	260	3
165	1	215	7	265	2
170	3	220	8	270	3
175	2	225	11	275	1
180	2	230	9	280	1
185	4	235	8	285	1
190	2	240	5	290	0
195	5	245	5	295	0
200	7	250	3	300	1

EXERCISE 2 ANSWER KEY

Step 3 - Compute the range for the data set

Points **Largest value** = 300

Smallest value = 155 Points

Range of values = 145 Points

EXERCISE 2 ANSWER KEY

Step 4 - Determine the number of intervals

*IF YOU HAVE THIS
MANY DATA POINTS*

*USE THIS NUMBER
OF INTERVALS:*

Less than 50

5 to 7 intervals

50 to 99

6 to 10 intervals

100 to 250

7 to 12 intervals

More than
250

10 to 20 intervals

EXERCISE 2 ANSWER KEY

Step 5 - Compute the interval width

The diagram illustrates the calculation of the interval width. It starts with a box labeled "Interval Width" followed by an equals sign. This is followed by a fraction where the numerator is "Range" and the denominator is "Number of Intervals". This fraction is set equal to another fraction with "145" in the numerator and "10" in the denominator. This is then set equal to a circle containing "14.5". An arrow points from a box labeled "Use 10 for the number of intervals" to the "10" in the denominator. Another arrow points from a box labeled "Round up to 15" to the "14.5" in the circle.

$$\text{Interval Width} = \frac{\text{Range}}{\text{Number of Intervals}} = \frac{145}{10} = 14.5$$

Use 10 for the number of intervals

Round up to 15

EXERCISE 2 ANSWER KEY

Step 6 - Determine the starting point of

each interval

Step 7 - Count the number of points in each interval

INTERVAL NUMBER	STARTING VALUE	INTERVAL WIDTH	ENDING VALUE	NUMBER OF COUNTS
1	155	+ 15	170	3
2	170	+ 15	185	7
3	185	+ 15	200	11
4	200	+ 15	215	12
5	215	+ 15	230	26
6	230	+ 15	245	22
7	245	+ 15	260	12
8	260	+ 15	275	8
9	275	+ 15	290	3
10	290	+ 15	300	1

Equal to or greater
than
the STARTING VALUE

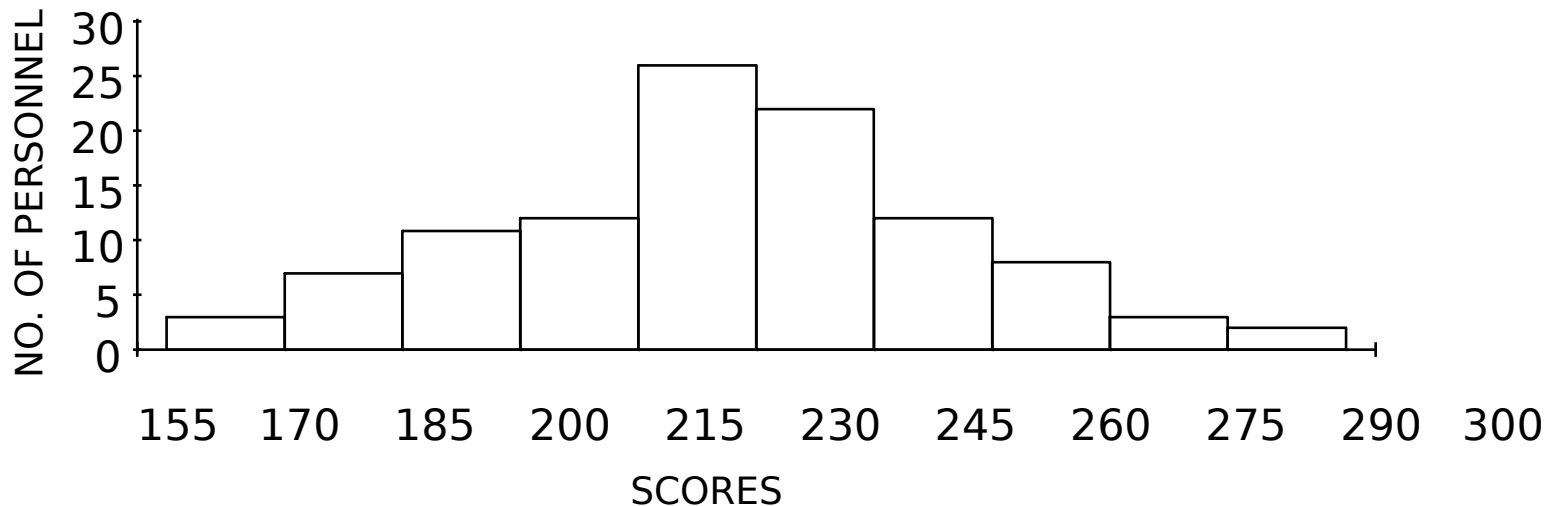
But less than
the ENDING VALUE

EXERCISE 2 ANSWER KEY

Step 8 - Plot the data

Step 9 - Add title and legend

MARKSMANSHIP SCORES FOR 9mm PISTOL



LEGEND: MCBH KANEOHE BAY, HI; AVERAGE OF 4 SCORES PER CLASS, 105 CLASSES, 1 JUNE 94 - 15 JULY